Seroprevalence of SARS-Cov-2 Antibodies in Adults, Arkhangelsk, Russia

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Population-based data on coronavirus disease in Russia and on the immunogenicity of the Sputnik V vaccine are sparse. In a survey of 1,080 residents of Arkhangelsk 40–75 years of age, 65% were seropositive for IgG. Fifteen percent of participants had been vaccinated; of those, 97% were seropositive.

Russia is one of the few countries to have produced a coronavirus (COVID-19) vaccine (*1*). It has also experienced substantial excess deaths during the pandemic (*2*). Few published estimates of antibody seroprevalence for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Russia exist. A St. Petersburg survey in June 2020 used random-digit dialing to contact 66,250 residents; of those, 1,038 provided a blood sample, and the samples had 9%–10% seropositivity (*3*). A study conducted in Chelyabinsk (September 28–December 30, 2020) recruited 1,091 high-risk workers (healthcare workers, education staff, and supermarket employees) ≥18 years of age. Of the 882 screened, 25% were seropositive for IgG (*4*). We are not aware of any seroprevalence estimates from Russia based on samples collected in 2021 that have appeared in the scientific literature.

We interviewed and obtained blood samples from 1,080 adults 40–75 years of age who were residents of the city of Arkhangelsk in northwest Russia during February 24–May 28, 2021. We obtained participants for this study from 2,258 invitations sent to persons who had taken part in the Know Your Heart study (*5*) (2015–2018), which was based on a random sample of the city population (Appendix, https://wwwnc.cdc.gov/EID/article/28/2/21-1640-App1.pdf). The ethics committee of the Northern State Medical University approved our study proposal and protocol on February 17, 2021.

We used a Vector Best ELISA assay (D-5501 SARS-CoV-2-IgG-EIA-BEST; https://vector-best.ru) to analyze qualitatively detected IgG directed against SARS-CoV-2 in human blood serum samples. Data are limited on the performance of this immunoassay, in particular, on its sensitivity for infections that occurred >3 weeks previously. According to the manufacturer, the assay has a sensitivity of 72% when performed 6–12 days after infection and ≈100% at 13–20 days (*6*). An independent assessment of the Vector Best ELISA assay found a sensitivity of 89% and a specificity of 100%, derived from comparisons of test results in prepandemic samples (negative controls) and PCR positive samples for SARS-CoV-2 (*7*). We estimated seroprevalence adjusted for test performance (89% sensitivity, 100% specificity) using the equation (crude prevalence + test specificity – 1)/(sensitivity + specificity – 1) (*8*). We calculated 95% CIs for the adjusted estimates of seroprevalence using the R package bootComb (https://www.r-project.org).

Of the 1,080 samples (634 women, mean age 55 years), we excluded 13 who had an equivocal test result from analysis. Of the 1,067 remaining samples, 690 (65%) were seropositive for IgG (Table 1). Seroprevalence adjusted for test characteristics was 72.6% (95% CI 64.2%–83.1%).

Seroprevalence did not substantively differ by sex or by educational level. Of the 162 participants (15%) who reported having been vaccinated. 150 (93%) were seropositive. Among the 31 who received 1 dose, 20 (65%) were seropositive; of the 131 who had received 2 doses, 130 (99%) were seropositive. Of the 905 participants who said they had not been vaccinated, 256 said that they had previously been ill with COVID-19; of those, 248 (97%) were seropositive. Of those who stated they had not been vaccinated and did not report having previously been ill with COVID-19, 292 (45%) were seropositive, suggesting an appreciable level of unrecognized infection. Our overall estimates of seroprevalence (crude 65%, adjusted 72.6%) is appreciably higher than found in St Petersburg in

Table. Seroprevalence of severe acute respiratory syndrome coronavirus 2 in adults, Arkhangelsk, Russia

Characteristic	Unvaccinated		Vaccinated*		Total	
	No. seropositive/ total (%)	Adjusted seroprevalence, % (95% CI)†	No. seropositive/ total (%)	Adjusted seroprevalence, % (95% CI)†	No. seropositive/ total (%)	Adjusted seroprevalence, % (95% CI)†
Sex						
F	332/553 (60)	67.4 (58.4–77.9)	72/81 (89)	99.7 (87.1–99.9)	404/634 (64)	71.5 (62.6–82.3)
M	208/352 (59)	66.3 (56.5–77.3)	78/81 (96)	100 (93.2–100)	286/433 (66)	74.1 (64.5–85.6)
Age, y						
40–54	291/461 (63)	70.8 (61.4;81.8)	35/38 (92)	100 (84.8–100)	326/499 (65)	73.3 (64.0–84.6)
55–64	181/317 (57)	64.1 (54.1–75.0)	38/43 (88)	99.1 (82.6–100)	219/360 (61)	68.3 (58.4–79.4)
≥65	68/127 (54)	60.1 (46.9–73.1)	77/81 (95)	100 (92.4–100)	145/208 (70)	78.2 (67.0–91.2)
Education						
Secondary and lower	26/47 (55)	62.1 (42.7–81.0)	9/9 (100)	100 (66.7–100)	35/56 (63)	70.1 (52.5–88.1)
Specialized secondary	253/433 (58)	65.6 (56.1–76.0)	81/87 (93)	100 (91.2–100)	334/520 (64)	72.1 (62.9–83.2)
Higher	261/425 (61)	68.9 (59.3–79.8)	60/66 (91)	100 (88.0–100)	321/491 (65)	73.3 (64.0–84.6)
Week of test						
7–14	395/651 (61)	68.1 (59.3–78,4)	49/58 (84)	94.8 (81.0–100)	444/709 (63)	70.3 (61.6–80.8)
15–21	145/254 (57)	64.0 (53.4–75.3)	101/104 (97)	100 (94.8–100)	246/358 (69)	77.1 (67.1–89.1)
Self-reported prior symptoms of infection						
No	172/477 (36)	40.5 (31.7–47.8)	133/143 (93)	100 (92.9–100)	305/620 (49)	55.2 (46.6–64.0)
Yes	248/256 (97)	100 (96.9–100)	8/9 (89)	99.7 (56.8–100)	256/265 (97)	100 (96.7–100)
Do not know	120/172 (70)	78.3 (66.5–91.6)	9/10 (90)	100 (60.4–100)	129/182 (71)	79.5 (68.1–92.8)
Total	540/905 (60)	66.9 (58.6–76.9)	150/162 (93)	100 (92.9–100)	690/1067 (65)	72.6 (64.2–83.1)

*Received ≥1 dose.
†Values >100% were rounded to 100%.
‡Weeks 7–14 are February 24–April 11 and weeks 15–21 are April 12–May 28, 2021.

June 2020 (*3*) (10%) or in Chelyabinsk (25%) in September–December 2020 (*4*). This result is consistent with the second wave of the pandemic in Russia (peak November–December 2020) being larger than the first (peak May–June 2020); our study started during the vaccination period.

Deployment of COVID-19 vaccine, mostly Sputnik V, in the Arkhangelsk region started in mid-January 2021; 11% of the population received ≥1 dose by May 30, 2021 (*9*). Our study covered an urban sample from the city of Arkhangelsk, the capital of the region. Our estimate of 15% coverage of the study population may be higher because the regional estimates included data from more dispersed communities in. Nevertheless, our vaccination rates were low compared with rates in most European Union and European Economic Area countries as reported in June 2021 by the European Centre for Disease Prevention and Control (*10*). Given the vaccination rate in the sample was 15% but the antibodies were present in 65% of participants, we suspect that most of the seropositive results were the result of acquired infection.

Russia is geographically the largest country in the world; its regions vary considerably in terms of socioeconomic level, climate, and healthcare provision. Our study results are restricted to an adult population and cannot be generalized to the total population of Arkhangelsk region or to Russia. The high levels of seroprevalence among vaccinated participants confirms the immunogenicity of the Sputnik vaccine and suggests that it can protect the population if the proportion vaccinated is increased substantially. We recommend further population-based seroprevalence studies, using World Health Organization–approved tests, for public health efforts in the COVID-19 pandemic.

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References

1. Logunov DY, Dolzhikova IV, Zubkova OV, Tukhvatulin AI, Shcheblyakov DV, Dzharullaeva AS, et al. Safety and immunogenicity of an rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine in two formulations: two open, non-randomised phase 1/2 studies from Russia. Lancet. 2020;396:887–97. https://doi.org/10.1016/S0140-6736(20)31866-3

2. Karlinsky A, Kobak D. Tracking excess mortality across countries during the COVID-19 pandemic with the World Mortality Dataset. eLife. 2021;10:10. https://doi.org/10.7554/eLife.69336
3. Barchuk A, Skougarevskiy D, Titaev K, Shirokov D, Raskina Y, Novkunkskaya A, et al. Seroprevalence of SARS-CoV-2 antibodies in Saint Petersburg, Russia: a population-based study. Sci Rep. 2021;11:12930. https://doi.org/10.1038/s41598-021-92206-y
4. Zurochka A, Dobrinina M, Zurochka V, Hu D, Solovyev A, Ryabova L, et al. Seroprevalence of SARS-CoV-2 antibodies in symptomatic individuals is higher than in persons who are at increased risk exposure: the results of the single-center, prospective, cross-sectional study. Vaccines (Basel). 2021;9:627. https://doi.org/10.3390/vaccines9060627
5. Cook S, Malyutina S, Kudryavtsev A, et al. Know Your Heart: rationale, design and conduct of a cross-sectional study of cardiovascular structure, function, and risk factors in 4,500 men and women aged 35–69 years from two Russian cities, 2015–18. Wellcome Open Research 2018;3:67. https://doi.org/10.12688/wellcomeopenres.14619.3
6. Kuvshinova IN, Nekrasov BG, Livitskaya NI, Molodykh SV, Rukavishnikov M. Sensitivity and specificity of reagent kits of JSC "Vector-Best" for the detection of immunoglobulins of different classes to SARS-CoV-2 [in Russian]. Spravochnik Zaveduyushchego KDL. 2021;10:27–32.
7. Barchuk A, Shirokov D, Sergeeva M, Tursunzade R, Dudkina O, Tychkova V, et al. Evaluation of the performance of SARS-CoV-2 antibody assays for a longitudinal population-based study of COVID-19 spread in St. Petersburg, Russia. J Med Virol. 2021;93:5846–52. https://doi.org/10.1002/jmv.27126
8. Sempos CT, Tian L. Adjusting coronavirus prevalence estimates for laboratory test kit error. Am J Epidemiol. 2021;190:109–15. https://doi.org/10.1093/aje/kwaa174
9. Government of Russia. The number of people vaccinated against coronavirus in Arkhangelsk [in Russian]. 2021 [cited 2021 Sep 20]. https://gogov.ru/covid-v-stats/arkhangelsk
10. European Centre for Disease Prevention and Control. Overview of the implementation of COVID-19 vaccination strategies and deployment plans in the EU/EEA, 14 June 2021. 2021 [cited 2021 Sep 20]. https://www.ecdc.europa.eu/en/publications-data/overview-implementation-covid-19-vaccination-strategies-and-deployment-plans

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Ulceroglandular Infection and Bacteremia Caused by *Francisella salimarina* in Immunocompromised Patient, France

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Although *Francisella tularensis* is a well-known, highly virulent bacterium that causes tularemia in humans, other *Francisella* species have been associated with sporadic human infections. We describe a human cutaneous infection with bacteremia caused by *F. salimarina*, a *Francisella* species recently identified from seawater and fishes, in an immunocompromised patient in France.

Although the taxonomy of the genus *Francisella* includes a wide diversity of species, only *F. tularensis* subspecies *tularensis* and *F. tularensis* subsp. *holarctica* cause the potentially life-threatening disease tularemia (*1*). Several *Francisella* spp., including *F. philomiragia*, *F. novicida*, *F. opportunistica*, and *F. hispaniensis*, are occasional opportunistic human pathogens; the other *Francisella* spp. are not associated with human infections (*1*). We describe a human infection caused by *F. salimarina*, recently identified from aquatic environments and fishes.

In June 2017, a 76-year-old man received a diagnosis of acute myelomonocytic leukemia and was admitted to Poitiers University Hospital (Poitiers, France). The patient lived in a small town 30 km from the Atlantic Ocean, had not travelled abroad recently, and had no pets. The day after admission, first-line chemotherapy of subcutaneous azacitidine was started for 7 days. After 3 days of chemotherapy, piperacillin/tazobactam was introduced for 5 days because of febrile aplasia. The patient was then discharged with

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Appendix

A potential limitation of this study is that the population we studied may not be fully representative of the target population of citizens of Arkhangelsk of the same age. This has 2 components. First, the sampling frame for the seroprevalence study was from the previous Know Your Heart (KYH) study conducted 2015–2018. KYH was itself based on a random sample of all persons 35–69 years of age residing in the city of Arkhangelsk. Although the response rate for this initial study was 53%, the educational profile of those who were recruited to the study was very similar to that expected on the basis of 2010 Russian Census data for the city (*1*). This finding, together with emerging evidence that response rates may not be as strongly related to nonresponse bias (*2*), suggests that although we sampled a particular age-range, the sampling frame is probably representative of the population of the city of Arkhangelsk.

The second issue of representativeness concerns the extent to which those participants in the recent seroprevalence study are similar in key respects to the sampling frame from the KYH study. Of the 2,380 KYH participants, we excluded 122 persons from consideration for the following reasons: 56 indicated at the KYH survey that they did not wish to be contacted to take part in further research, 61 had died before the study inception date, and 5 were ≥75 years of age. Overall, 2,258 people were invited to take part in 2021; a total of 1,080 (47.8%) provided blood samples for assessing seroprevalence.

We have compared the similarity of the 1,080 participants in the seroprevalence survey to the 2,380 persons in the sampling frame (Appendix Table). The sex and age distributions were very similar. However, the proportion of participants with higher education in the 2021 seroprevalence study was larger than in the sampling frame. However, we did not observe an association between education and seroprevalence, at least among the responders.

Our study had several limitations. Samples were taken over 4 months during February 24–May 28, 2021, because the fieldwork was nested within a much larger national multicenter

survey of the prevalence of risk factors of cardiovascular diseases in Russia (study ESSE-RF-3). Participants of this study underwent extensive tests as part of the ESSE-RF-3 protocol. Capacity limitations meant that we could invite a maximum of 25 participants per day. We noted, however, that the ESSE-RF study itself aimed to get a representative sample of the population and was in no way restricted to those who had cardiovascular problems. Although we collected the samples over an extended period during which the infection rates changed, we regard our estimate as an average of positivity over the period studied. Nevertheless, we could underestimate the seroprevalence due to low sensitivity in the 12 days following infection or sensitivity waning with increased time from the disease onset. Finally, a limitation of our findings was the small sample sizes we used for some of our analyses.

References

1. Cook S, Malyutina S, Kudryavtsev AV, Averina M, Bobrova N, Boytsov S, et al. Know Your Heart: rationale, design and conduct of a cross-sectional study of cardiovascular structure, function and risk factors in 4,500 men and women aged 35–69 years from two Russian cities, 2015-18 [version 2–referees: 3 approved]. Wellcome Open Research 2018;3 https://doi.org/10.12688/wellcomeopenres.14619.1

2. Hendra R, Hill A. Rethinking response rates: new evidence of little relationship between survey response rates and nonresponse bias. Eval Rev. 2019;43:307–30. https://doi.org/10.1177/0193841X18807719

Appendix Table. Comparisons of participants in study of seroprevalence of severe acute respiratory syndrome coronavirus 2 antibodies, Russia

Characteristic	Resurvey sample, N=1,067 (%)	Know Your Heart study, N=2,380 (%)	p value
Sex*			
F	629 (59.0)	1,377 (58.3)	0.72
M	438 (41.0)	985 (41.7)	
Median age at baseline, quartiles Q1 and Q3	51 (Q_1=44–Q_3=59)	54 (Q_1=45–Q_3=62)	<0.01†
Education*			<0.01
Secondary and lower	56 (5.2)	174 (7.4)	
Specialized secondary	520 (48.7)	1,269 (53.7)	
Higher	491 (46.0)	919 (38.9)	

*Determined by χ^2 test.
†Determined by Mann–Whitney U-test.